The project aims at providing open, standardised solutions to the growing demand for personalised, adaptive content discovery and delivery in heterogeneous, dynamic environments by developing a content-oriented, vendor-mixed infrastructure accessible to any content provider.

The overall objective in this project is to design seamless content delivery by focusing on interlayer interactions in order to:

- Define vendor-independent solutions for CDN components by means of open APIs with respect to mutual interlayer interaction (network infrastructure, content distribution and content service layer) and appropriate security aspects;
- Achieve dynamic interpretation and adaptation of services and content with respect to the current requests of a user and his/her environment (group of users), content discovery and the overall CDN environment;
- Complement such technical development with an appropriate innovation of a business model for content distribution, content delivery and requested services.

The overall objective will support the versatile deployment of CDNs of providers and the community. Furthermore, open interfaces between different layers and their flexibility will enable vendor independent solutions and composition of CDNs, which are able to match better the specific requirements of enterprises and companies. In particular, mCDN is focusing on the following main objectives:

- To develop business models for content-aware delivery networks and to consider the broader socio-economic implications of content and service delivery, including peer-to-peer (P2P) networks.
- To develop an open, adaptable, technology independent architecture and system model for personalised multimedia content discovery and delivery.
- Provisioning of appropriate network state feedback for important performance and Quality of Service parameters via open interfaces to optimise content distribution and retrieval.
FP6 Summary of Projects

- To evaluate the Internet Engineering Task Force’s (IETF) standardisation work on a flexible content/service discovery framework by applying it to the mCDN architecture, and by means of open source reference implementations, in particular of the Internet Media Guide Unidirectional Point-to-Multipoint Transport protocol (MUPPET).
- To provide better support for users by means of Internet Media Guides (IMG) and optimised content retrieval by taking into account the status of lower CDN layers: in particular the case of content retrieval with real-time requirements.
- To dynamically offer of personalised services to meet the requirements of users with respect to their preferences, device capabilities, and the current network state.
- To support personalised content discovery to meet the user expectations and demands.
- To support dynamic composition of a CDN consisting of peer-to-peer groups and fixed established CDNs with dynamically assigned roles to allow for better utilisation of the component CDNs.
- To implement a reasonable set of components to demonstrate the functionality of interlayering as specified in the content service and delivery interlayering architecture, including an easy to use programming environment for third party application developers to access content-oriented services.
- To validate of the content service and delivery interlayering architecture through prototype demonstrations and their evaluation.
- To disseminate the results to relevant standardisation bodies, conferences etc.

**Technical approach:**

The mCDN project has defined a multi-layered approach, dividing the work in several categories, as depicted in the following figure.
The network infrastructure layer provides the physical components like user devices, servers, routers and cabling. Both, wired and wireless network infrastructures will be considered in the mCDN project. The content distribution layer is responsible for the content distribution and the native content retrieval. Caches, proxies and servers in arbitrary topology pattern are the key components of this layer. The content service layer is using the availability of the content to provide services to requesting users. The mCDN project is examining the boundaries between these layers and is focussing the research work on the interactions of these layers. More specifically:

The network infrastructure layer is providing well-defined services, dealing with the delivery of network state information to either the content distribution or the service layer by means of measuring and monitoring. In case of P2P networks, the information is statistically collected and can be used either to find alternative routes or used by providers for better network utilisation and content placement. Well-defined APIs can be used by the higher layers in network nodes to use these network services.

The content distribution layer is invoking these network services to provide optimised placement of content, content discovery and delivery in P2P networks, and to optimise the delivery in case of real-time constraints. Furthermore, the information is used to optimise the typical management tasks of content delivery in regard to network resources, type of the content and content retrieval statistics.

The mCDN project will also focus on service personalisation and content discovery through the implementation of the IMG. In addition, the mCDN project will cover all the security aspects of content service discovery and distribution including the specific issues related to P2P-based CDNs. All mCDN layers will interact through open interfaces enabling the composition of multi-vendor CDN solutions. Furthermore, the mCDN architecture will CDN platforms to take into account the location of the content, the overall network state, the user profile and the capabilities of the requesting device enabling the optimum delivery of personalized content services.

Key issues:

- Develops open interfaces that will enable service and application layers to communicate with the network layers in real-time and retrieve network state information guaranteeing end-to-end QoS during the content delivery process.
- Incorporates a flexible security architecture, dependent on the business models and the composed services, that will ensure content encryption and personal data protection.
- Implements an open source Internet Media Guide (IMG), based on the reference content/service discovery mechanism proposed by the IETF.
- Develops personalisation and content adaptation mechanisms based on the user profile, device capabilities and content characteristics to enhance the content retrieval process.
- Enables dynamic composition of Content Delivery Network Nodes consisting of P2P groups and fixed modules with dynamically assigned roles to allow for better utilisation of CDN resources.

Expected impact:
The mCDN project is providing an architecture consisting of open interfaces that enables personalized content retrieval, optimised utilization of network resources and cost efficient QoS provisioning allowing operator to customize the CDN solution offered to the business models and the customers requirements. The provisioning of open interfaces between the network and the application layers enable network-state feedback allowing CDNs provider to realize adaptive accounting and billing models based on the delivered level of QoS. Furthermore the dynamic exchange of network information between Content Delivery Network nodes utilizing P2P techniques will ensure better utilization of CDN resources and improve the content discovery process.

As a part of the mCDN project effort, an open source reference implementation of a service discovery system called Internet Media Guide (IMG) will be prepared. Work on IMGs is currently an ongoing activity in the MMUSIC (Multimedia Multiparty Session Control) working group of IETF (Internet Engineering Task Force). Preparation of a public reference implementation is an essential part of IETF’s standardisation process. Thus, by developing an open source reference implementation of IMG, the mCDN project will give a significant contribution to the standardisation of IMGs in IETF.

In addition, mCDN incorporates a flexible security concept based on the providers' business models and composed services. Finally, mCDN enables the personalisation and adaptation of content enabling provider to offer value-added content retrieval services.